New LANL Facility for Coated Conductor Fabrication, Characterization and Applications

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Accelerated Coated Conductor Development via the Research Park Facility

1) Scaled-up fabrication
   - Transition to production by industry
   - Longer samples available for analysis and applications
2) High-throughput materials experimentation
   - Test bed for new ideas
   - *In-situ* diagnostics
3) Increased interaction with partners
   - Co-location of outside partners
   - User facility, training
4) Applications testing lab
   - Lab with unique capabilities for evaluating conductors
   - Capability for testing prototype applications

STC Labs at the Research Park

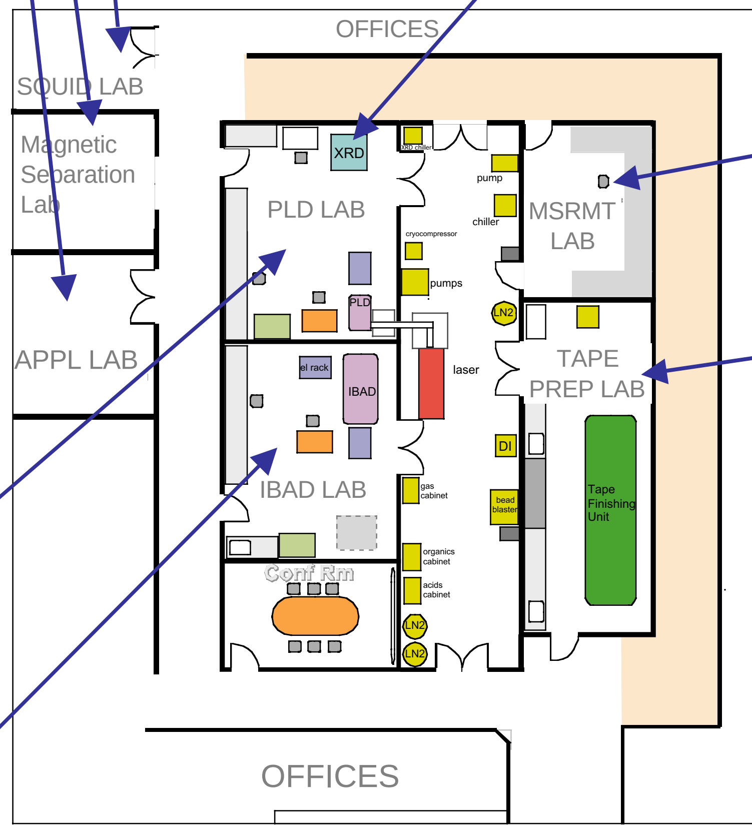
- 4 new labs for Coated Conductor preparation and 3 for applications development
- CC preparation labs with reel-to-reel tape systems

Applications Labs

X-ray Diffraction

Measurements Lab

Tape Finishing Lab



Pulsed-Laser Deposition Lab

Ion-Beam Assist Deposition Lab

Research Park - June 2001

Research Park - August 2001




Research Park: Oct. 2001 - Feb. 2002

Research Park - July 2002

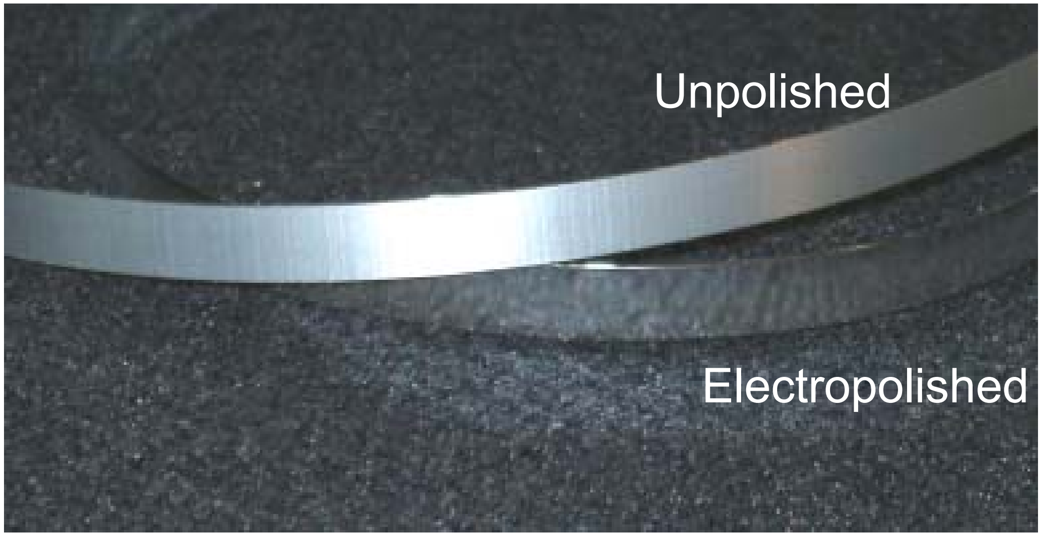
IBAD Lab

IBAD template tapes on reels

PLD Lab

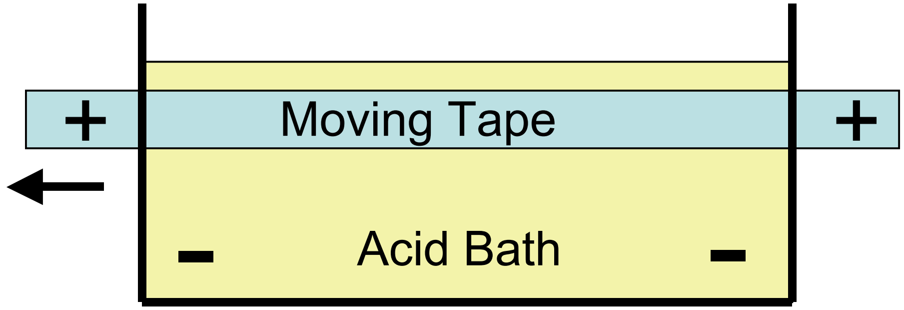
Tape Finishing

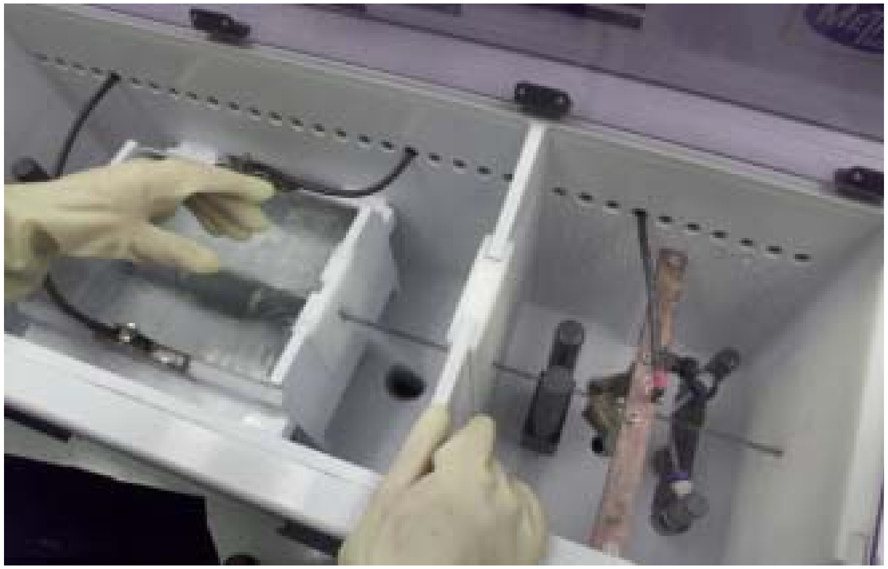
- Coated conductors require starting prepared metal tapes with smooth and clean surfaces
- New industrial-type equipment processes reels of metal tape by electropolishing
- Capable of reel-to-reel polishing of tape at high speed up to km lengths
- Capabilities for tape finishing research, including electroplating



Electropolishing cell

- tape speed: 15 - 30 m/hr
- voltage: 5 - 12 V
- current: 5 - 25 A

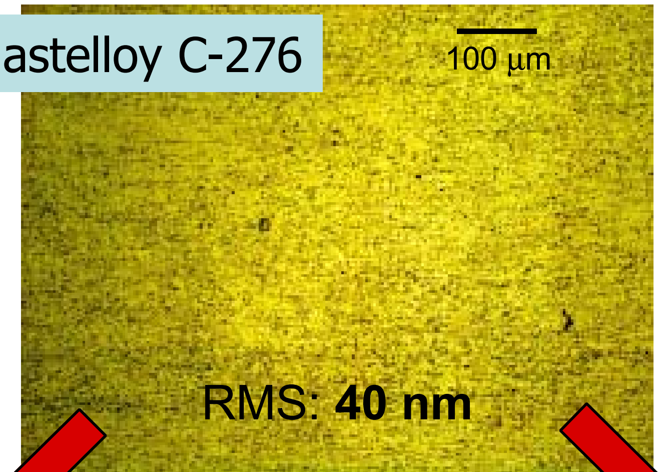




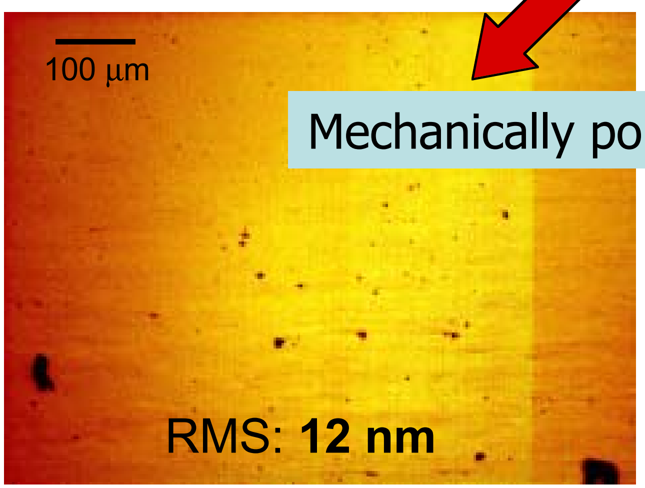
Results on Surface Smoothing: Optical micrographs

RMS roughness from atomic force mircrographs over 50 µm x 50 µm area

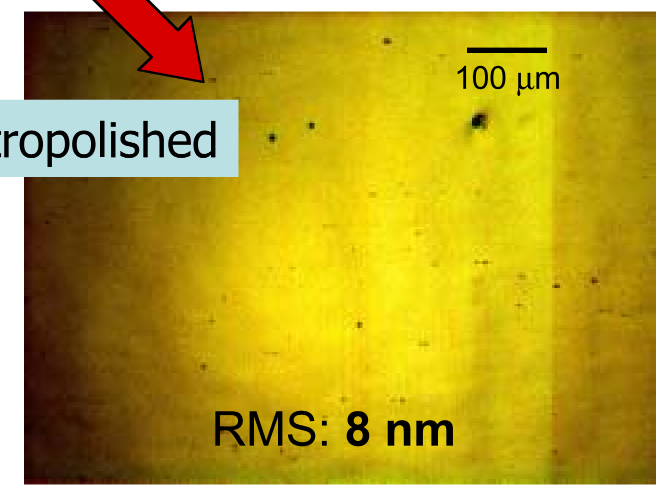
Unpolished Hastelloy C-276



Mechanically polished

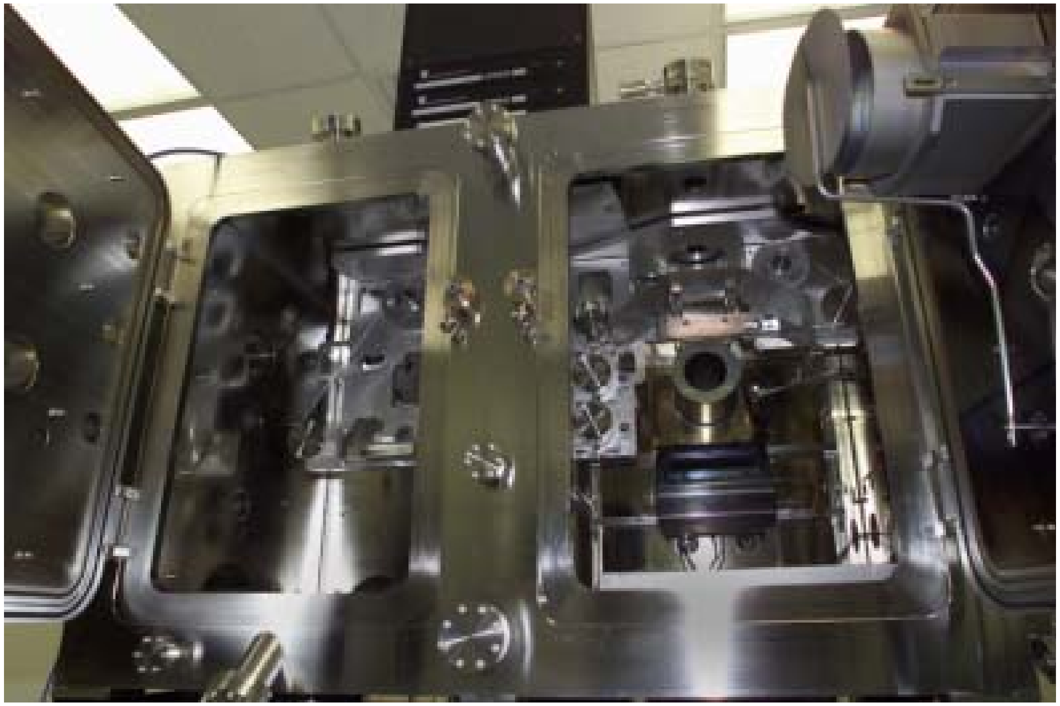


Electropolished



Ion-Beam-Assisted Deposition Chamber

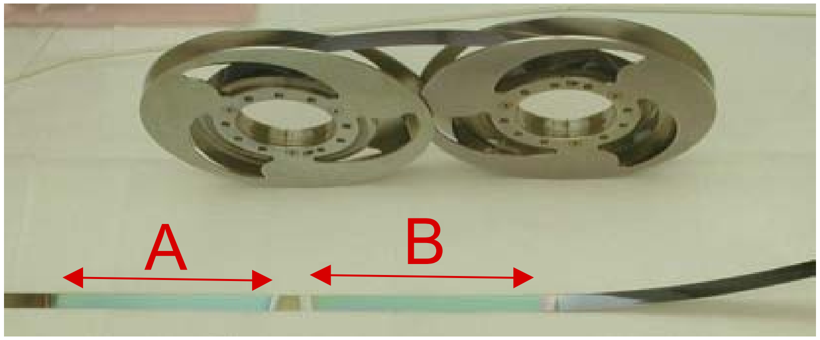
- Large vacuum chamber (6′x4′x3.5′)
- Capability for process integration (IBAD and buffer layers)
- Reel-to-reel system provides for tape lengths over 100 meters
- 3000 - 6000 l/s pumping speed: < 2 hrs to pump, vent in 10 minutes: quick turnaround



Sequential Combinatorial Research from Continuous Tape Processing

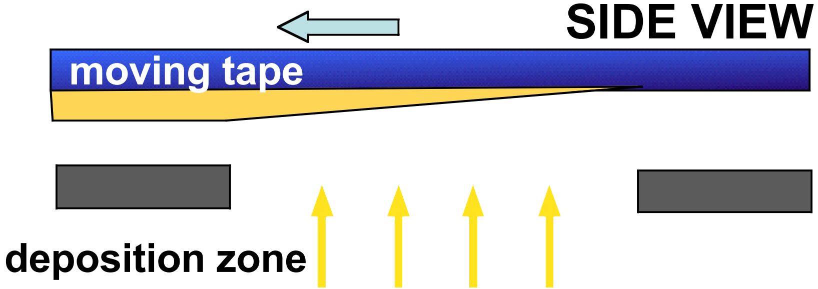
- Continuous tape processing is ideal for exploring process parameters in a sequential way
- We can track positions on tape from one process step to the next and develop a matrix of experiments (either continuously or in stationary batches)

A and B have different buffer layers on top of IBAD-MgO



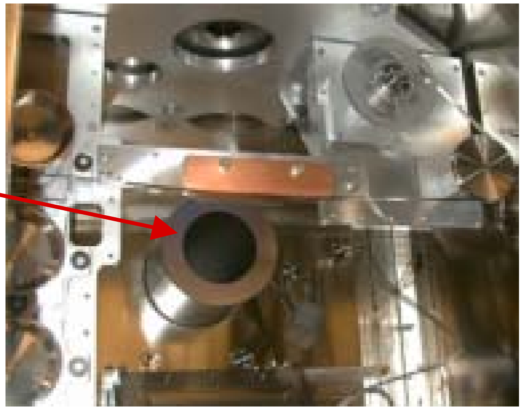
- Such combinatorial research provides for a high-throughput of experiments (100's of experiments in 1 reel) - *in-situ* evaluation
- Currently using this method for optimization of deposition processes
- IBAD process transferred successfully from Paul Arendt's lab to Research Park

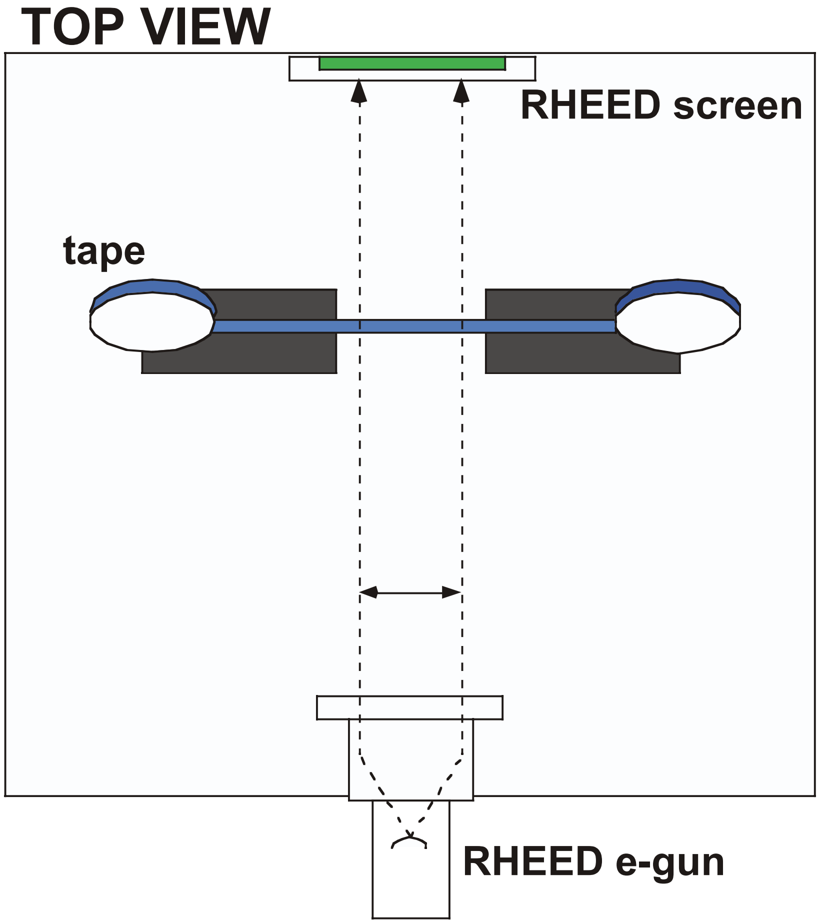
Parallel Scanning RHEED for Continuous IBAD



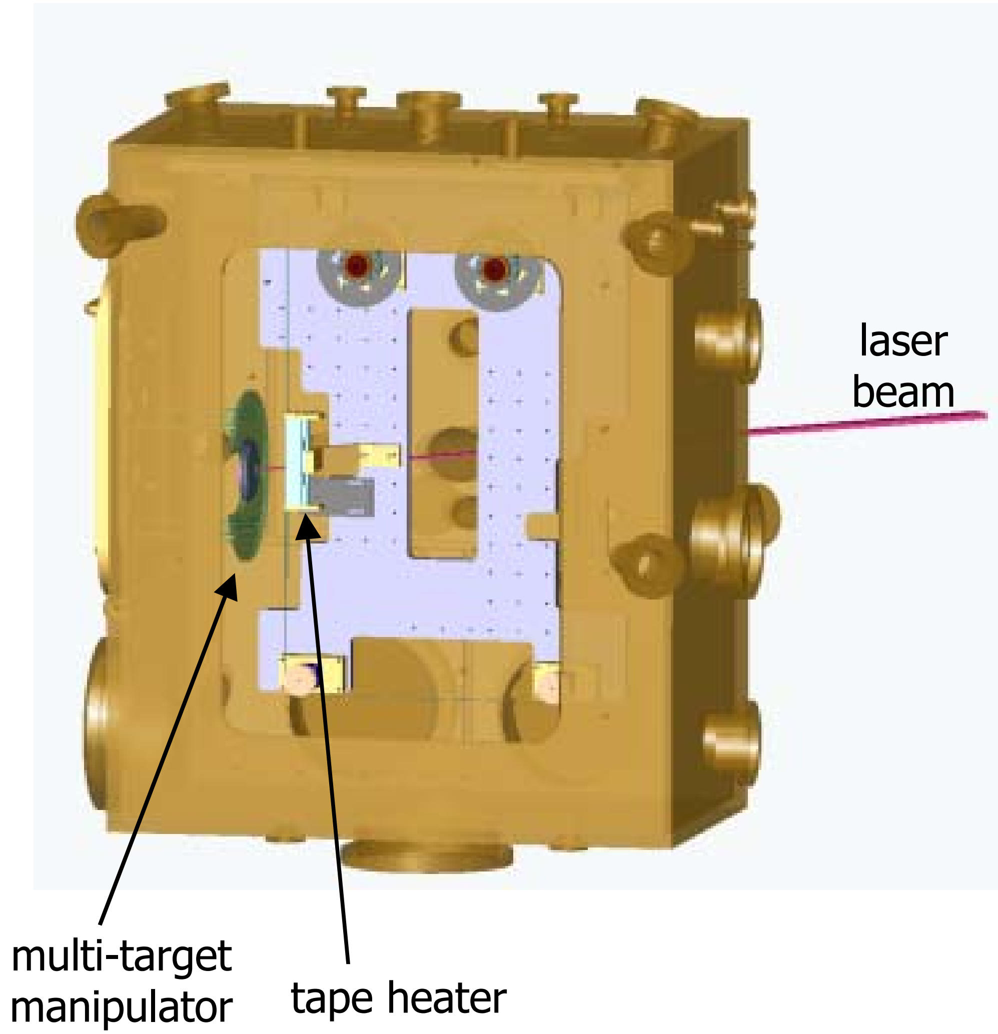
- By scanning the RHEED beam along the tape one obtains RHEED images at different stages of IBAD growth

RHEED gun





Pulsed-Laser Deposition Chamber



- Four 4” targets for deposition of a variety of oxide layers
- Quartz lamp heater allows for heating of tape as it continuously moves through the PLD zone
- *In-situ* adjustment of tape position with respect to laser plume
- Silver deposition integrated

Pulsed-Laser Deposition Chamber

- Relatively large chamber for PLD (4′x3.5′x2′)
- Easy access via front and side doors
- 4000 l/s pumping speed, chamber pumps down in 1 hour
- Industrial 200 W XeCl (308 nm) laser is used for PLD